REMARKS

The present amendment is being submitted along with a request for continued examination (RCE) and in response to the Office action dated August 26, 2008.

Applicants sincerely appreciate the withdrawal of the rejections under 35 U.S.C. § 112, paragraphs 1 and 2. Applicants further appreciate the examiner's approval and entry of Figure 3, added June 11, 2007, and the Substitute Specification, filed August 6, 2008.

Rule 1.131 Declarations of Prior Invention of Claim 48 Subject Matter Predating Zimmerman 7,027,918

Reconsideration of the Rule 1.131 declarations by the inventors, including the date-stamped disclosure documenting conception of the invention, is respectfully requested in light of new, independent claim 48. The applicants' sworn statements, considered with the documentary evidence of conception of the claimed invention prior to the effective reference date and due diligence from prior to the reference date to the application filing date (April 23, 2003), clearly comply with 37 CFR 1.131(b) for purposes of showing prior invention of the presently-claimed subject matter.

The applicable dates are as follows:

January 28, 2003 Michael Whitehead (coinventor) documentation of concept of, *inter alia*, redundant array of GPS receivers constrained by distance and/or geometry and/or time (common clock or synchronized clocks) on either side of a wall or on a marine vessel with a large crane obstructing a common view of all available satellites. Each receiver "sees" only a subset of the available satellites. E.g., each receiver seeing three satellites enables a position solution involving six unknowns, three position signals and one clock signal locating the

master receiver, and two position signals providing a bearing to the slave receiver.

April 7, 2003 Zimmerman 7,027,918 filing (effective) date

April 23, 2003 Present application filing date.

The evidence of prior invention was considered insufficient because the Whitehead written disclosure dated January 28, 2003 did not specifically reference limitations in the *previous* claims, such as locating a remote point position. New claim 48, which is the only independent claim in this application, overcomes this objection by closely following the Whitehead disclosure, as shown in the attached Conception of Claim 48 Invention 1/28/03 (Attachment A) wherein the Whitehead disclosure is shown to fully support claim 48.

Secondly, the evidence of prior invention was rejected because the statement that the ideas expressed have been "kicking around the company for the last several years" was considered insufficient to show that applicants conceived and reduced to practice the claimed subject matter. As noted by the examiner, conception is the mental part of the inventive act and is more than a mere vague idea of how to solve a problem. The means themselves and their interaction must be comprehended also. MPEP 715.07 and *Mergenther v. Scudder*, 1897 C.D. 724, 81 O.G. 1417 (D.C. Cir. 1897). However, Rule 1.131 has separate requirements for "conception" and "reduction practice." Specifically, conception prior to the effective date of the reference must be coupled with due diligence from prior to the reference date (April 7, 2003) to the filing date the application (April 23, 2003, constructive reduction practice). MPEP 715.07

Inventor Whitehead's written disclosure date-stamped January 28, 2003 succinctly and comprehensively documents conception of the claimed invention, i.e. using master and slave GPS receivers constrained by distance and/or geometry and/or time (by a common clock or synchronized clocks) on either side of a wall or on a marine vessel with a large crane with a satellite-obstructing object blocking a common view of all available satellites.. The GPS receivers, satellite constellation with partial subsets,

common clock, solution computing, constraints and multipath mitigation are all discussed, as well as their interactions. In fact, the prior disclosure provides a specific example involving receivers on both sides of a wall (or ship with satellite-obstructing crane structure) with each receiver seeing only three satellites. The solution utilizes six measurements for six unknowns, which are specifically divided between the master and slave receivers with the distance/geometry constraints and the time constraints removing two unknowns, thus enabling a solution with six measurements whereas previous systems would have required eight measurements, four each for the two receivers.

The conception of the claimed invention by January 28, 2003 is demonstrated by the attached Conception of Claim 48 Invention 1/28/03 (Attachment A) correlating the claim elements with the disclosure. Moreover, conception is corroborated by the sworn statements of both of the inventors, Michael Whitehead and Walter Feller. Although certain ideas may have been "kicking around" for some period, they were concisely and succinctly pulled together in the January 28, 2003 disclosure, conclusively showing conception a few months prior to the reference effective date.

The second Rule 1.131 element, due diligence in reduction to practice, is measured from a time prior to the reference date (April 7, 2003) to the application filing date (April 23, 2003). MPEP 715.07 Filing the application, and thus constructively reducing the invention to practice, within approximately two weeks of the reference date clearly and conclusively demonstrates due diligence. The January 28, 2003 Whitehead disclosure discloses every aspect of new claim 48. Based on the foregoing, applicants respectfully request that Zimmerman 7,027,918 be withdrawn.

Prior Art Distinguished

Claim 48 is the only independent claim remaining in the application. It calls for a method for determining the GNSS-defined positions of master and slave receivers on a structure including a satellite-blocking object. The antennas are constrained by distance, geometry and time (by a common clock or synchronized clocks) relative to each other and the structure. Due to satellite blockage, at least one of the antennas sees three or fewer satellites and the other antenna sees at least three satellites.

The antennas are mounted on the structure for mitigating multipath effects. A position solution comprising the GNSS-defined positions of the antennas is determined using an equation with six unknowns, four for the position and time at the master receiver and two for a bearing from the master antenna to the constrained slave antenna. The position of the master antenna, the distance/geometry constraints, the common clock or synchronized clocks (clock constraint) and the multipath mitigation are all used for determining the position solution.

Dizchavez 6,191,733 discloses equipment with two GPS antennas for determining the position of critical working components, such as a shovel bucket 16, based on sensors for determining the working components' positions relative to a car body 12. However, it does not disclose signal-blocking, distance/geometry/time constraints for removing unknowns from a position solution equation or multipath mitigation based on the satellite-blocking object. Moreover, the Dizchavez point of interest (e.g., on the shovel bucket 16) moves relative to the car body 12 and therefore is not a constrained point, as contrasted with applicants' claimed invention with constrained receivers for which positions are determined. Dizchavez is basically an attitude determination system utilizing a full complement of satellite signals at each antenna, and fails to address the partially-blocked satellite problem for which the applicants' claimed invention provides a solution.

Wilson 6,292,132 (Figure 2) shows GPS antennas and receivers in a constrained relation on a single vehicle for maintaining position information when fewer than four satellites are visible. The system calculates "cone angles" between the antenna-processor pairs sharing a common clock, which are used along with an initial position fix for combining with sensor-generated (e.g., steering wheel input) information for estimating a position by "dead reckoning." However, the antenna-processor pairs see the same satellite sets and the system is essentially relative positioning based on the *initial* point. By contrast, in applicants' claim 48 method, the antennas collectively "see" a complete four-satellite set, although each antenna only sees a. subset due to the satellite-blocking object. Hence the present invention enables a complete position/attitude solution without the need of inertial navigation devices, which Wilson relies on for dead

reckoning navigation. Although Wilson discloses detecting multipath environments by comparing and correlating the two receivers (4:34-67 and 5:1-23), the claimed invention is distinguished by the claimed step of mitigating multipath using the antenna mounting for averaging or canceling multipath effects.

Rorabaugh 6,922,635 (Figure 4) shows an unconstrained system of independent mobile units 101A and 101B on opposite sides of a blocking structure 115 whereby each sees a different subset of satellites. Positioning the Rorabaugh mobile units is relative, i.e. relative to others of a wirelessly networked group of receivers mounted on respective mobile units. Thus, the distance/geometry/time (common clock or synchronized clocks) constraints of applicants' claimed invention are not present. The Rorabaugh system would therefore not provide an attitude/position solution locating the two constrained receivers on the structure, with each receiver seeing three satellites but collectively forming a complete position solution. Claim 48 is further distinguished by its multipath mitigation step involving the receivers being constrained relative to each other and seeing different satellite subsets.

Hanseder 6,253,160 discloses a machine control with antennas and receivers for RTK tool positioning control. However, the purpose of the second antenna and receiver are for calibrating the tool. Figure 2 shows temporary placement of the antenna 13B on the tool (bucket) for calibration relative to the excavator 1. The present invention is distinguished by several claimed features, including the distance/geometry/clock constraints enabling an attitude/position solution with partially-blocked antennas each seeing only a subset of an available satellite constellation, multipath mitigation and other distinguishing features.

Dooley 6,618,671 shows a method of determining the relative position of a mobile unit, such as a cell phone. However, it does not involve a structure with multiple constrained antennas and receivers for determining an absolute position.

Toda et al. 6,611,228 show carrier phase-based relative positioning for a marine vessel (Figures 8A-C) with antennas positioned in constrained relations on opposite sides of the vessel for providing its attitude and relative position. However,

there is no disclosure of the antennas seeing partial subsets of the available satellites because of a signal-blocking structure, nor an orientation device providing information for computing a position solution in unison with positioning information from the receivers, nor of unknowns being thereby eliminated from the position solution equations.

Tang et al. 5,933,110 show a ship docking system using a pair of wing-mounted, constrained GPS receivers for calculating position, velocity and heading, particularly for a ship in a docking maneuver. However, there is no disclosure of an antenna-blocking object whereby the GPS receivers use measurements from partial subsets of the available GPS satellites, with the claimed attitude/position determining steps including multipath mitigation resulting from the claimed structure configuration with the satellite-blocking object.

Conclusion

Based on the foregoing, claim 48, which is the only independent claim, distinguishes over the references of record singly and in combination. The novel method of claim 48 involves constraining the antennas on a structure by distance, geometry and clock, with the structure including a satellite-blocking object whereby each antenna only sees a subset of the available satellites. The claimed method develops an attitude/position solution using fewer GNSS measurements than would otherwise be required for locating unconstrained master and slave antennas independently by constraining the antennas. The satellite-blocking object on the structure is located between the antennas whereby each sees a different satellite subset. Important advantages of the claimed method include attitude/position solutions in blocked-satellite environments with the constraints enabling solutions with fewer measurements, and multipath mitigation based on the averaging and canceling effects from multiple antennas constrained by distance.

As noted above, the prior art includes multiple, constrained antennas for attitude determination, and multiple unconstrained antennas in blocked-satellite environments. The environments in which these prior art systems operate include machine control, ship docking and vehicle navigation/guidance, including networks of

separate vehicles. However, none of the prior art references, taken singly or in combination, would solve the problems of constrained antennas in a blocked-satellite environment with the distance/geometry/clock constraints removing unknowns from the position solution equation using the claimed solution-determining factors and providing multipath mitigation. For example, the applicants' January 28, 2003 disclosure provides an example where each receiver sees a subset of three satellites due to an intervening wall, crane, etc., but a position solution is nevertheless possible because of the distance/geometry/clock constraints and the steps of receiving and processing the measurements in unison. None of the references of record provides any teaching, suggestion or motivation for solving this problem with the claimed method, or otherwise makes claim 48 obvious.

Based on the foregoing, this application is in condition for allowance and notice to this effect is respectfully requested.

The Commissioner is authorized to charge any excess fees, or credit any overpayments to Deposit Account No. 50-3424. The examiner is invited to contact the undersigned by telephone if prosecution of this application can be expedited thereby.

Respectfully Submitted,

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Nov. 26, 2008

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CONCEPTION OF CLAIM 48 INVENTION 1/28/03

Claim 48 (new)	Whitehead Disclosure Date-stamped 1/28/03, Attachment A to Whitehead Rule 131 Declaration.	Comments
A method for determining a GNSS-defined position of a constrained single point fixedly positioned on a structure including a signal-blocking object, which system comprises:	Obtain a location of one or more receivers. (¶ 2, lines 1-2) Situation where one or more of the GPS receivers are only seeing a small subset of the available satellites. (¶ 2, lines 10-11) For example, one receiver on one side of a wall sees 3 satellites, and another on another side of the wall sees 3 satellites. (¶ 2, lines 12-14) Instead of a wall, this [structure] could be a ship with a large crane obstructing the common view to all satellites. (¶ 2, lines 18-19)	Significance is that position solution could not be obtained conventionally because each receiver would have to "see" 4 satellites minimum.
providing master and slave GNSS receivers;	Using a redundant array of GPS receivers to obtain a location for one or more of these receivers. (¶ 2, lines 1-2)	
providing master and slave antennas connected to said master and slave receivers respectively and mounting said antennas in fixed, spaced relation with said satellite-blocking object between them;	The location of each receiver is constrained relative to the other receiver by a fixed distance and/or geometry and/or common clock. (¶ 2, lines 2-3) For example, one receiver on one side of a wall [or ship-mounted crane] sees 3 satellites, and another on another side of the wall sees a different subset of 3 satellites.	Each receiver includes its own antenna which sees only a subset of the available satellite constellation. Corresponds to object at least partially blocking GNSS signals from the antennas.

mounting the antennas for independent multipath effects;	(¶ 2, lines 12-14 and 18-19) multipath and other sources of noise may be independent at each GPS receiver, averaging out the effects of noise. (¶ 2, lines 7-9)	
constraining said antennas relative to each other by a fixed distance and a fixed geometry;	The location of each receiver is constrained relative to the other receiver by a fixed distance and/or geometry and/or common clock. (¶ 2, lines 2-3)	
providing a common clock or synchronized clocks connected to said receivers;	The location of each receiver is constrained relative to the other receiver by a fixed distance and/or geometry and/or common clock. (¶ 2, lines 2-3)	
receiving at one said antennas to GNSS signals from at least three satellites; receiving at the other antenna signals from no more than three satellites due to the satellite-blocking object;	For example, one receiver on one side of a wall [or ship-mounted crane] sees 3 satellites, and another on another side of the wall sees a different subset of 3 satellites. (¶ 2, lines 12-14 and 18-19)	
determining a position solution comprising the GNSS-defined position to the antennas using:		
(1) a position solution equation 6 unknowns comprising three location unknowns and one clock on known for the master antenna;	Receivers use common [constrained] clock separated by known [constrained] distance so 6 measurements (e.g., 3 at each antenna), you	

	have a total of 6 measurements and 6 unknowns (4 unknowns for location and clock of one receiver...). (¶ 2, lines 15-17)	
two unknowns in the position solution equation for the bearing of the slave antenna relative to the master antenna;	Receivers use common [constrained] clock separated by known [constrained] distance so six measurements (e.g., three at each antenna) include two for the bearing of the other receiver. (¶ 2, lines 2-3 and 15-18)	Orientation is determined from the fixed (constrained) distance/geometry/common clock, which provide the master-to-slave antenna bearing. The antennas are constrained on the structure and therefore the antenna-to-antenna bearing is used to determine the structure orientation.
(2) master antenna position;	(4 unknowns for location and clock of one receiver...). (¶ 2, lines 16-17)	"One" receiver corresponds to master.
(3) known antenna distance and geometry constraints	The location of each receiver is constrained relative to the other receiver by a fixed distance and/or geometry and/or common clock. (¶ 2, lines 2-3)	
(4) GNSS signals received at receivers and utilized in computing position solution in unison by operation of common clock or synchronized clocks; and	By receiving GPS signals and computing the solution in unison, we gain the advantage of adding measurements to the equation faster than we do unknowns. (¶ 2, lines 3-5)	Advantage of adding measurements to the equation faster than we do unknowns as compared to the situation of unconstrained GPS receivers for which the location is computed independently for each. (¶ 2, lines 5-7)
(5) multipath mitigation by averaging multipath effects at said antennas due to said antennas being mounted for independent multipath effects.	Since multipath and other sources of noise may be independent at each GPS receiver, the method has the advantage of averaging out the effects of noise. (¶ 2, lines 7-9)	Blocking object (e.g., wall or crane) causes antennas to "see" different satellite constellation subsets, which mitigates multipath by averaging effects among the antennas.